

**Non-Invasive Archaeological Investigations for the Aberdeen Western Peripheral Route
(AWPR Package)**

Project code: AWPR-002

Employer: AWPR Managing Agent

Consultant: Jacobs UK Ltd

**ABERDEEN WESTERN PERIPHERAL ROUTE PACKAGE
(SOUTHERN LEG)**

Hare Moss Wetland (Site 153)

Palaeoenvironmental Assessment



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Date: 30th November 2012

Report Reference No.: AWPR-SL-012



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Contract:	Non-Invasive Archaeological Investigations for the Aberdeen Western Peripheral Route (AWPR Package)
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Schedule	
Fieldwork	August 2012
Report	November 2012

SUMMARY

Palaeoenvironmental survey using a manual gouge auger was conducted across Hare Moss Wetland (Site 153), an area of wetland identified as having the potential to contain sediments of palaeoenvironmental potential on the Southern Leg of the New Aberdeen Bypass road scheme prior to any construction work being undertaken. The aims of the survey were to establish the presence of any deposits of palaeoenvironmental interest (e.g. peats and organic muds); establish the depth and nature of these deposits and their likely chronology; and establish the potential of these deposits to inform on landscape change in order to provide recommendations for the mitigation of impact deemed necessary to alleviate the impact of the development.

The results of the survey showed that peats were present and that these peats existed as pockets of deep peat with shallower peats spread across the area. At Hare Moss Wetland a maximum peat thickness of 1.45m was recorded in the eastern part of the site. Peat was observed as having accrued over infilled shallow water bodies, which formed within small hollows in the landscape. The peat sequences suggest the formation of sedge and grass swamp communities with trees and/or saplings, followed by a retrogressive transition to reed swamp before returning to a drier vegetation cover of sedge and grasses, together with trees onto the peatland, likely to represent taxa such as birch, alder and willow. The sequence is then capped by a peaty podzol forming as the area effectively dried out and is now used largely as pastoral land.

Despite the relatively shallow depth of the peats, other studies located near to this site and from across Aberdeenshire, have shown that they have the potential to have begun accruing during the early Holocene. This has been shown from both radiocarbon dated sequences and from pollen assemblages of non-dated sequences (showing species typical of an early Holocene environment). The peat sequence at Hare Moss Wetland overlies a series of silts and clays and thus contains a probable Early Holocene record of open water through to fen and carr-woodland development followed by a retrogressive reedswamp stage. It is therefore recommended that a core be taken from this location in order to investigate these vegetational changes and provide a solid chronology for vegetation development and change. The sequence will also provide an opportunity to investigate the presence of early human populations in this area against this backdrop of vegetation change.

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1 Introduction

1.1 General

- 1.1.1 This document is submitted as the report on the palaeoenvironmental assessment of Hare Moss Wetland (Site 153) located on the proposed route of the Southern Leg of the Aberdeen Western Peripheral Route. The palaeoenvironmental assessment is part of a programme of archaeological non-invasive investigations to facilitate the construction of the Aberdeen Western Peripheral Route (AWPR) and associated schemes. The work was undertaken in accordance with a specification prepared by Jacobs UK Ltd within the Invitation to Tender (ITT) (Aberdeen City Council 2012).
- 1.1.2 The AWPR is proposed as both a bypass and a distributor road around the City of Aberdeen. The route envisages the construction of a wholly new dual carriageway some 34.6km long around Aberdeen, together with a link to Stonehaven some 11.5 km long, and includes associated side roads and junctions. The AWPR is divided into three sections; the Northern Leg, Southern Leg and Fastlink (Illus 1).
- 1.1.3 The Employer is the AWPR Managing Agent, administrator of the Commission on behalf of Aberdeen City Council (ACC) and its funding partners. The Consultant is Adam Brossler of Jacobs UK Ltd. The Contractor is Headland Archaeology (UK) Ltd, the archaeological organisation appointed by the AWPR Managing Agent to carry out the work reported here. Historic Scotland provides advice, supervision and oversight of the content, conduct and quality of archaeological aspects of the Contract, acting in support of Transport Scotland.
- 1.1.4 On the 22nd-23rd of August 2012 and 22nd of October 2012 Headland Archaeology undertook the palaeoenvironmental assessment of Site 153 (Hare Moss Wetland) to the specification provided in the ITT (Aberdeen City Council 2012). This project was managed by Russel Coleman (Contract Manager) and Sorina Spanou (Project Manager). Fieldwork for this survey was undertaken by Dr Scott Timpany and Steve Roe. Reporting was undertaken by Dr Scott Timpany.

1.2 Background to the Project – AWPR

- 1.2.1 Desk-based assessment undertaken in support of the cultural heritage chapter of the Environmental Statement (ES) identified a total of 316 sites of cultural heritage significance along or close to the route (Jacobs UK Ltd 2007). Chapters 13 (Northern Leg), 28 (Southern Leg) and 43 (Fastlink) (Cultural Heritage and Archaeology) of the ES for the scheme recommends measures to be undertaken to evaluate or mitigate potential impacts of the scheme on the cultural heritage resource. These recommendations include both invasive and non-invasive archaeological evaluation followed by archaeological mitigation.

1.2.2 Based on the requirements of the ES and the results of subsequent dialogue with Historic Scotland, the following non-invasive archaeological investigations are required across all sections of the scheme:

- topographic survey;
- palaeoenvironmental assessment;
- geophysical survey;
- field walking;
- metal detector survey; and
- building recording

1.2.3 The present report deals with the palaeoenvironmental assessment of Hare Moss Wetland (Site 153) located on the proposed Southern Leg of the AWPR route.

1.3 Aims and Objectives

1.3.1 The general aim of the archaeological non-invasive investigations is to identify the extent and character of known and unknown archaeological remains in order to enable a programme of mitigation to be designed. More specific aims and objectives are as follows:

1.3.2 An area of peatland, Hare Moss Wetland (Site 153) was identified along the Southern Leg route of the proposed AWPR scheme. This area has been identified as having potential to contain deep sediment sequences of peats and silts, which are of palaeoenvironmental significance. The waterlogged, anaerobic nature of these sediments means that they preserve microfossils (e.g. pollen, diatoms) and macrofossils (e.g. seeds, wood) that can be used to reconstruct the landscape history of this area. The presence of such deposits also means there is potential for the discovery of cultural materials within them, such as wooden objects and structures. The main objective for the palaeoenvironmental surveys of these areas is to determine the palaeoenvironmental and archaeological potential of these deposits.

1.3.3 The key aims to achieve this objective are:

- to establish the presence of any palaeoenvironmentally significant deposits within the target areas;
- to establish the depth of any palaeoenvironmentally significant deposits within the target areas;
- to establish the nature of the deposits and the depositional processes of the sediments within the target areas;

- to establish the potential of these deposits to inform on landscape change in the local and wider regions of the target areas.

1.3.4 The results will be disseminated through deposition of an ordered archive and a detailed report at the National Monument Records of Scotland (NMRS), and publication at a level of detail appropriate to the significance of the results.

1.3.5 The results of the non-invasive investigations will enable a more accurate assessment of the potential impact of the scheme on archaeological remains and the design of any further evaluation works and an appropriate programme of mitigation works (if necessary). Such works will form part of a separate contract.

1.4 Site Location & Description

1.4.1 The site of Hare Moss Wetland (Site 153) lies approximately 0.3km east of the hamlet of Little Bishopston and c. 7.3km south-west of the city of Aberdeen (Illus 1). The site lies on the Skene coastal lowland formation, which was significantly effected by the Devensian ice-sheets, causing intense scouring of the landscape and subsequent burial of this eroded surface beneath till (sands and gravels) deposits as the ice-sheets retreated and melted (Murdoch, 1975; Tipping, 2007). The site itself is a linear area stretching some 2.7 km in length and up to 0.3km in width. The area is mainly fields of rough pasture used for grazing of livestock together with horse paddocks. At the eastern end of the site, pasture is replaced by a plantation of fir woodland. The main area of Hare Moss is located outside of the road take area to the immediate north of the western end of the site; the road take area just touching on the southern extent of the moss.

2 Method

2.1 Fieldwork

2.1.1 A manual gouge auger with a 1000 x 30mm chamber was used in the field to investigate the depth and nature of the deposits present. A total of 44 auger points (APs) were undertaken across Hare Moss Wetland (Site 153). At each AP the type and depth of sediments encountered was recorded using the Troels-Smith (1955) guide to sediment characterization, together with the presence of any visible plant macrofossils such as wood fragments. Augering was conducted until contact with the pre-Holocene surface was established or until impenetrable strata (e.g. stone) were encountered. The position of all APs was surveyed in the field using a handheld GPS with a Wide Area Augmentation System (WAAS).

2.1.2 All field records and other products of the work shall be archived with the National Monuments Record of Scotland (NMRS) and the Royal Commission on the Ancient and

Historical Monuments of Scotland (RCAHMS), following and adhering to its standards and guidance for project archiving (RCAHMS 1996a, b).

2.2 2D Contour Map Reconstruction

- 2.2.1 The auger and survey data collected in the field have been entered into a digital surface mapping and contouring program (SURFER10) to produce a 2D contour model of peat thickness across the targeted area (Illus 3). The model uses the data collected in the field to interpolate the thickness and presence of peats across the area. Information has been taken from geotechnical logs of borehole and test pit data (Norwest Holst 2006) together with the auger data from the field work results to construct the 2D maps.

3 Palaeoenvironmental Background of Peat Formation in the Study Area (Aberdeenshire)

- 3.1 In order to place the peat deposits of this study within the regional context for Aberdeenshire, the following section provides an overview of palaeoenvironmental work that has been done to date in this Area of Interest (AOI) in Aberdeenshire (defined as within 20km of the planned route of the new road). Reference is also made to some sites outside of this area; the location of all sites mentioned is presented in Illustration 2. This overview is primarily concerned with the depths of peat encountered and chronology of peat development within this part of Aberdeenshire.
- 3.2 There are two types of peatlands present across the AOI, blanket peats and raised mires. Raised or ombrotrophic mires differ from blanket peats as they receive all their water from precipitation, as such they hold key records of palaeoclimate change through reconstructing changing precipitation rates to show periods of wet and dry climate (e.g. Barber *et al*, 1994, 2000; Langdon and Barber, 2005). Raised mires get their name from the dome that forms, usually in the middle of the mire, as peat accrues; the mires developing usually over infilled shallow lakes or basins. Conditions at the edge of the raised mire are usually much wetter and can often be found to support *Sphagnum* (usually *Sphagnum cuspidatum* and *Sphagnum fallax*) communities in pools or as lawns (e.g. Durno, 1957). Blanket mires develop where peat spreads out from initial foci, such as small upland basins. The spread of blanket mire can occur over a relatively rapid period (Tipping, 2008). Tipping (2007) notes that it would undoubtedly have had a considerable impact upon any human populations living in effected areas.
- 3.3 Illustration 2 shows that there have been a reasonable number of palaeoenvironmental and peatland studies within the AOI. However, as noted by Tipping (2008) in a recent review of palaeoenvironmental work that has been undertaken across Aberdeenshire as a whole, a considerable number of these studies lack radiocarbon dates, which would allow their studied sequences to be placed in a chronological context. It is worth noting that of the ten studies located within the AOI only two have assigned radiocarbon dates (Vasari, 1977 and Tipping *et al* unpublished). This lack of dating evidence is largely

ascribed to the age of the studies, when radiocarbon dating was relatively new and not done as standard.

- 3.4 This lack of dating evidence means that few definitive ages can be placed on the age of peat development across the AOI. However, Late Glacial peat development is thought to be unlikely, with Tipping (2007) observing that sites where such peats have been recorded as accruing during this period lie outside of this area. Where they occur, seems to be in scattered locations across Aberdeenshire (Illus 2), such as at Garral Hill where peat formation has been dated to 14,454-13,331 cal BP (Q-101; 11,350±300 BP) at a depth of 2.2m (Godwin and Willis, 1959). Another such site is Woodhead, Fyvie where peats have been dated to 12,851-12,556 cal BP (SRR-1723; 10,780±50 BP) (Connell and Hall, 1987). These peats are then capped by overlying solifluction deposits (of silts and/or clays) marking the Younger Dryas Stadial (Tipping, 2007).
- 3.5 Vasari (1977) has recorded organic muds (gyttja) deposits of Late Glacial date at Loch of Park, a lake site which lies within the AOI. These have been dated to 14,570-13,286 cal BP (HEL-417; 11,900±260 BP) from lake sediments at a depth of 3.4m. However, as no lake coring is within the remit of these works it is thought there is low potential for peats of such age to be encountered.
- 3.6 Early Holocene peat development has been recorded within the AOI at Moss-side, near Aberdeen, where peat formation has been dated as taking place at 9540-9470 cal BP (SUERC-17352; 8505±30 BP) at a depth of 0.75m overlying a previous pond of open water (Tipping *et al*, unpublished). While outside of the AOI at places such as St Fergus Moss, near Peterhead peat development has been recorded as starting at between 9650-9290 cal BP (SUERC-35407; 9950±35 BP) and 9470-9420 cal BP (SRR-6640; 8328±51 BP), at depths of 4.68m and 2.55m, respectively (Timpany *et al*, 2011; Clark and Edwards, 2004). Peats and organic mud sediments of Early Holocene date have also been recorded at sites in the Cairngorms (e.g. Pears, 1975a, 1975b; Rapson, 1985; Huntley, 1994) leading Tipping (2007) to postulate that peat initiation began in Aberdeenshire during the period 10,600-9800 cal BP.
- 3.7 The variation seen in the depths at St Fergus Moss, together with the early dates from the relatively shallow sequence at Moss-side highlights that depth of sediments alone cannot be used to determine the likely age of peats encountered. The difference in peat depths is seen across the AOI with peat depths of between 0.75m at Moss-side (Tipping *et al*, unpublished) and 6.59m at Netherley Moss (Durno, 1956, 1957, 1961) recorded. This variation in depth will also no doubt be controlled by factors, such as the geomorphic setting of the site and whether they have been affected by later anthropogenic alteration such as agricultural activity, which may remove the upper layers of some deposits.

4 Results

- 4.1 The sediments encountered across much of Hare Moss Wetland (Site 153) were shallow sequences between 0.18m (AP42) and 0.90m (AP25) in depth (Illus 3). Previous borehole and test pit data has also shown the existence of peats of up to 0.90m (ELTP07) in this area (Norwest Holst, 2006). Sequences in excess of 0.90m were found at only seven locations across the site (AP8, AP11, AP22, AP26, AP28, AP36 and AP38); with the deepest sequence of 1.75m present at AP36 (Appendix 1). These shallow sequences largely consist of a dark brown peaty podzol soil with an upper layer containing modern root material of c. 0.04-0.20m in thickness and below this coarse sand and sub-angular to angular gravel inclusions. This peaty podzol achieved a maximum depth of 0.75m at AP5. In several locations peats were present underlying this peaty podzol unit (e.g. AP16), which are discussed below. Where no peats are present the peaty podzol is found to directly overlie a brown to grey silty, medium sand unit with sub-angular and angular gravels; this unit is considered to represent a glacial till layer (e.g AP40).
- 4.2 Peats are present across much of Hare Moss Wetland (Site 153), which are seen to achieve maximum thickness of 1.45m at AP38 at the eastern end of the site (Illus 3). The sedimentary sequence from AP36 is provided in Table 2. The upper layers of the sequence at AP38 (Unit I) consisted of the peaty podzol layers that extend across most of the Hare Moss Wetland site (see above). Underlying this peaty podzol unit was a dark brown peat with visible monocotyledon plant fragments (representing plants, such as grasses and sedges) and wood fragments (Unit II), indicating periodic tree presence, while sedges and grasses would have occurred throughout this phase of peat growth. Below this peat is a dark brown reed peat (Unit II) containing visible fragments of common reed (*Phragmites australis*), but no visible wood fragments, indicating a treeless, reed swamp environment. The peats are underlain by stone at the bottom of the sequence.

Table 1 - Sedimentary sequence of deepest peat at AP38, Site 153 (Illus 3)

Unit	Sediment	Depth (m)
I	Dark brown upper peaty podzol with modern roots	0-0.08
I	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	0.08-0.22
II	Dark brown peat with visible monocotyledon plant fragments and wood fragments	0.22-1.62
II	Dark brown reed peat with visible <i>Phragmites</i> fragments	1.62-1.67
-	Stone	1.67

- 4.3 At AP36, located near AP38 the peat sequence appears to extend further back in time, despite having shallower peat sequence of 1.08m in thickness (Table 2, Illus 3). Here a similar reed peat with visible *Phragmites* fragments was present at depths of between 0.91 to 1.23m below ground surface. Underlying this reed peat was found to be a dark brown-black well humified peat, (Unit II) which contained visible monocotyledon plant fragments again indicating a largely tree-less local landscape of sedges and grasses. Occasional charcoal fragments present within this layer suggest episodes of burning occurred locally during this period of peat formation. A further peat horizon was present below this peat layer of a dark brown peat with monocotyledon plant and wood fragments both visible suggesting the growth of local trees or saplings with a field layer of grasses and sedges. Seeds of bog bean (*Menyanthes trifoliata*), a plant which grows in the wetter parts of bogs and fens and at the edges of lakes (Clapham et al, 1962; Stace, 1997) were also visible in this peat layer. Underlying this peat layer is a sequence of minerogenic deposits of silt and clays (Units V and III), suggesting the presence of a former waterbody across this part of the site. These in turn overlie a layer of blue-grey silty, clayey medium to coarse sand (Unit IV), which is likely to represent the basal coarser elements of sediments associated with this waterbody. As at AP38 the sequence is underlain by stone.
- 4.4 Away from the deepest peats at the eastern end of the site, two other areas of deep peats can be seen, in the central area of the site and at the western end of the site (Illus 3). In the central area, peat sequences of up to 1.09m (AP22) in thickness were recorded. The peats in these areas are similar to the upper peat sequences recorded at AP36 and AP38 consisting of dark brown to black peats with visible monocotyledon plant and wood fragments, which again indicate the presence of local tree growth with grasses and sedges present in the field layer. At the western end of the site peats of up to 1.02m (AP8) in thickness are present. The peats in this area are similar to the upper sequences of AP36 and 38 together with the peats in the central areas such as at AP22, consisting of dark brown peats with monocotyledon plant and wood fragments. A reed peat with visible fragments of common reed is present below the monocotyledon and wood peat at AP26 at depths of between 0.90 and 1.28m. This peat appears to be similar to that found in AP36 and AP38 and indicates a period of reed swamp development in this location. The deep peats in these central and western areas are seen to be underlain by a mixture of stone, gravelly clays and gravelly sands; the latter suggested to represent glacial till. Full results of the sequences at all the AP locations are provided in Appendix 1.

Table 2 - Sedimentary sequence at AP36, Site 153

Unit	Sediment	Depth (m)
I	Dark brown upper peaty podzol with modern roots	0-0.2
I	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	0.2-0.52
II	Dark brown peat with visible monocotyledon plant fragments and wood fragments	0.52-0.91
II	Dark brown reed peat with visible Phragmites fragments	0.91-1.23
II	Dark brown-black peat with monocotyledon plant fragments and occasional charcoal fragments	1.23-1.46
II	Dark brown peat with visible monocotyledon plant fragments, wood fragments and <i>Menyanthes trifoliata</i> seeds.	1.46-1.60
V	Grey fine sandy silt	1.60-1.63
III	Blue-grey fine sandy, silty clay	1.63-1.65
V	Grey-brown clayey silt	1.65-1.69
III	Blue-grey medium to coarse sandy, silty clay	1.69-1.71
IV	Blue-grey silty, clayey, medium to coarse sand	1.71-1.75
-	Stone	1.75

5 Discussion

- 5.1 The results of the auger survey have shown that peats are present across much of the site at Hare Moss Wetland (Site 153), but that for the most parts these peats are shallow, with deep sequences being present in only seven of the 44 auger points (Illus 3). Maximum peat thickness at Hare Moss Wetland (Site 153) was recorded as 1.45m at the eastern end of the site. The results show deep peats are not present as a continuous layer across the site but rather they are present in pockets from the west to the east of the site. The sedimentary sequence from these pockets of deep peats indicates that they formed initially from small hollows which contained water (indicated by the presence of blue-grey and brown silts and clays), that gradually infilled with vegetation allowing peats

to develop. The peats and the visible plant remains they contain suggest that initial infilling of these waterbodies led to colonisation by monocotyledon plants such as sedges and grasses, together with herbs including bog bean. Wood fragments within this layer indicate trees or saplings also colonised these areas. A retrogressive succession then appears to take place, with a reed peat present overlying this basal peat in auger points, such as at AP36. Such retrogressive successions occur when there is an increase in wetness in these areas and may signify a rise in ground water levels or increased water flow into this area. Following this reed peat phase the overlying peats show a return to the previous environment with sedges, grasses and trees returning as indicated by the presence of monocotyledon plant and wood fragments within the peat. The return of these plants indicates that water levels had decreased in the area or that peat accretion rate was higher than any rate of water increase (e.g. ground water). The sequences are topped by a peaty podzol across the site, which indicates the drying out of the area allowing for soil development rather than continued peat accretion.

- 5.2 A maximum peat thickness of 1.45m indicates that the peats at Hare Moss Wetland (Site 153) are among some of the shallower peat sequences recorded within this part of the AOI. At nearby Netherley Moss (Illus 2) peats have been recorded of 6.59m in depth, which although undated are suggested from the pollen records to date from the early Holocene (Durno, 1956, 1957, 1961). Although relatively shallow the peat sequences at Hare Moss Wetland have the potential to date to the Early Holocene. This is also shown by the stratigraphy of the deeper peat sequences (e.g. AP36), which shows an evolution from former lake of likely Early Holocene date through to sedge and wood peat of probable Mid-Holocene date. Radiocarbon dated peats in the area, such as at Moss-side, near Aberdeen have shown that even shallow peats may have formed during the early Holocene (Tipping *et al*, unpublished), with the tops of the peats having been lost to later anthropogenic activity (e.g. ploughing and peat cutting).
- 5.3 Despite the lack of radiocarbon dates for many of the sites, the pollen records have confirmed the Early Holocene date for peat initiation by containing assemblages typical of these initially treeless landscapes and subsequently recording the migration of trees back into this area (e.g. Fraser and Godwin, 1955, Durno, 1961, 1970). Where dates have confirmed the establishment of peats during this period, pollen records have also been able to show the presence of people in the landscape and their impact on the local environment from the Mesolithic (e.g. Edwards, 1979, 1990; Edwards *et al*, 2000) through to relatively recent times (e.g. Edwards and Rowntree, 1980). Thus the sequence from Hare Moss Wetland has similar potential. However, in the area around Hare Moss Wetland there have been no significant archaeological finds nor are there any visible archaeological monuments present.

6 Conclusion

- 6.1 Auger survey work at Hare Moss Wetland (Site 153) on the Southern Leg of the AWPR, revealed the presence of peat across much of the site with pockets of deep peats (>0.90m) present in only a few locations.
- 6.2 Maximum peat thickness at Hare Moss Wetland (Site 153) was found to be 1.45m.

- 6.3 The peats showed a sequence of initiation from infilled pools of water, through to sedge swamp and woodland, then a transgressive reed swamp stage before returning to sedge swamp and carr-woodland environment.
- 6.4 Despite the relatively shallow depth of the deepest peats encountered at Hare Moss Wetland (Site 153), other studies peat studies in Aberdeenshire have shown peat initiation may still have begun in the early Holocene.
- 6.5 The peats have the potential to contain pollen sequences that can inform on tree migration and vegetational change, together with anthropogenic activity.

7 Statement on the Palaeoenvironmental Potential and Recommendations for Mitigation

- 7.1 The presence of peat indicates there is good potential for the presence of waterlogged plant remains (e.g. pollen, seeds) which can provide information on the vegetational history of this site. The observation of well preserved monocotyledon plant remains, seeds and wood fragments within the peats also indicates good potential for the preservation of plant remains. The dated peat sequences and pollen assemblages from undated peat sequences in this area of Aberdeenshire (e.g. Durno, 1956, 1961) indicate that peats in this area developed largely during the early Holocene. The presence and activities of early human populations in the Mesolithic period has also been evidenced from pollen studies in this area (e.g. Edwards, 1979, 1990; Edwards and Ralston, 1984). Thus the peat sequences within these areas have the potential to further knowledge of early Holocene landscape change and human interaction with the environment during this period.
- 7.2 The lack of radiocarbon dated early Holocene sequences within the AOI means that the sequences present at Hare Moss Wetland provide a good opportunity to investigate this period and provide a solid chronology (through radiocarbon dating) for vegetation development and change. It is recommended that a core is taken from AP36, which contains peats, silts and clays showing the transition from open water through to fen and carr-woodland development. Further investigation of these deposits using methods such as pollen and diatom analysis, will allow this probable Early Holocene landscape to be more fully understood, including the development of fen and carr-woodland from an open water environment, through to the retrogressive reedswamp stage. The sequence will also provide an opportunity to investigate the presence of early human populations in this area against this backdrop of vegetation change.

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9 Appendices

9.1 Appendix 1 Survey results

Unit key:	1	Peaty Podzol	
	2	Peats	
	3	Clays	
	4	Sands	
	5	Silts	
	6	Mor Humus	

Site 153

Auger Point	Depth (cm)	Sediment	Unit
1	0-07	Dark brown upper peaty podzol with modern roots	1
	07-30	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	30-33	Grey-brown peaty clay (palaeosol?)	3
	33-37	Grey clay with coarse sand and sub-angular to angular gravel inclusions	3
	37	Stone	-
2	0-04	Dark brown upper peaty podzol with modern roots	1
	04-19	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	19-23	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand and bands of orange medium sand.	1
	23-24	Black humified peat band	2
	24-26	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand and bands of orange medium sand.	1
	26-28	Grey coarse sand and sub-angular to angular gravels	4
	28	Stone	-
3	0-10	Dark brown upper peaty podzol with modern roots	1
	10-28	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	28-37	Dark grey-brown silty coarse sandy, clay.	3
	37-45	Light grey clayey, fine sandy silt	5

	45	Stuck	-
4	0-09	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	09-45	Grey coarse sand and sub-angular to angular gravels	4
	45-51 51	Stone	-
5	0-16	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	16-75	Dark brown peat with wood fragments	2
	75-76	Wood fragment	2
	76-78	Grey coarse sand and sub-angular to angular gravels	4
	78-79	Stuck	-
	79		
6	0-05	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	05-52 52	Stone	-
7	0-15	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	15-38	Dark red-brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	38-64	Grey coarse sand and sub-angular to angular gravels	4
	64-65 65	Stuck	-
8	0-11	Dark brown upper peaty podzol with modern roots	1
		Dark brown peat with monocotyledon plant fragments.	2
	11-61	Dark brown peat with monocotyledon plant fragments and occasional wood fragments.	2
	61-76	Dark brown peat with monocotyledon plant fragments and inclusions of sub-angular to angular gravels and medium to coarse sand.	2
	76-86	Dark brown peat with monocotyledon plant fragments and occasional wood fragments.	2
	86-107	Dark brown clayey, reed peat with visible <i>Phragmites</i> fragments.	2
	107-113	Dark grey-brown slightly peaty clay.	3
	113-115		

	115-125	Grey silty, clayey coarse sand with sub-angular to angular gravels.	4
	125	Stuck	-
9	0-10	Dark brown upper peaty podzol with modern roots	1
	10-29	Dark brown peat with monocotyledon plant fragments and occasional sub-angular to angular gravels.	2
	29-35	Dark brown peat with monocotyledon plant fragments and sub-angular to angular gravels.	2
	35	Stone	-
10	0-10	Dark brown upper peaty podzol with modern roots	1
	10-23	Dark brown-black peat with monocotyledon plant fragments.	2
	23-41	Dark brown-black peat with monocotyledon plant fragments and wood fragments.	2
	41-52	Dark brown clayey, peat with monocotyledon plant fragments and occasional wood fragments.	2
	52	Stone	-
11	0-30	Black Sphagnum peat	2
	30-100	Partial recovery of dark brown peat with monocotyledon plant fragments.	2
	100	Stone	-
12	0-11	Dark brown upper peaty podzol with modern roots	1
	11-30	Dark brown-black peat with monocotyledon plant fragments.	2
	30-47	Dark brown-black peat with monocotyledon plant fragments and wood fragments.	2
	47-54	Dark brown-black, slightly clayey peat with monocotyledon plant fragments and occasional wood fragments.	2
	54-57	Grey-brown slightly peaty clay	3
	57-63	Dark grey-brown clayey, coarse sand and sub-angular to angular gravels.	4
	63	Stone	-
13	0-06	Dark brown upper peaty podzol with modern roots	1
	06-24	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	24-27	Black humified peat layer	2
	27-30	Dark brown peat with inclusions of sub-angular to angular gravels and medium to coarse sand.	2
	30-33	Brown silty peat with sub-angular gravels	2
	33	Stone	-
14	0-06	Dark brown upper peaty podzol with modern roots	1

	06-27	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	27-30	Black humified peat layer	2
	30-34	Brown silty peat	2
	34	Stone	
15	0-08	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	
	08-29	Brown coarse sand and sub-angular to angular gravels	1
	29-30	Stuck	4
	30		-
16	0-06	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	
	06-30	Black well humified peat	1
	30-32	Dark brown peat with inclusions of sub-angular to angular gravels and medium to coarse sand.	2
	32-37	Brown coarse sand and sub-angular to angular gravels	2
	37-38	Stuck	4
	38		-
17	0-08	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	
	08-38	Brown peaty silt	1
	38-42	Stone	5
	42		
18	0-07	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	
	07-25	Stuck	1
	25		-
19	0-06	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	
	06-21	Brown silty coarse sand with sub-angular and angular gravels.	1
	21-25	Stuck	4
	25		-
20	0-20	Dark brown upper peaty podzol with modern roots	1

	20-70	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	70-72	Brown silty coarse sand with sub-angular and angular gravels.	4
	72-75	Grey silty coarse sand with sub-angular and angular gravels.	4
	75	Stuck	-
21	0-31	No recovery	-
	31-67	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	67-68	Orange-brown silty coarse sand with sub-angular and angular gravels.	4
	68	Stuck	-
22	0-12	No recovery	-
	12-95	Dark brown-black peat with monocotyledon plant fragments.	2
	95-109	Dark brown-black peat with monocotyledon plant fragments and wood fragments.	2
	109	Stone	-
23	0-09	Dark brown upper peaty podzol with modern roots	1
	09-52	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	52-56	Dark grey peaty clay with visible <i>Phragmites</i> fragments	3
	56	Stone	-
24	0-06	Dark brown upper peaty podzol with modern roots	1
	06-23	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	23-44	Black peat with monocotyledon plant fragments and wood fragments.	2
	44	Stone	-
25	0-14	Dark brown upper peaty podzol with modern roots	1
	14-30	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	30-90	Black, slightly clayey peat with monocotyledon plant fragments and wood fragments.	2
	90	Stone	-
26	0-07	Dark brown upper peaty podzol with modern roots	1

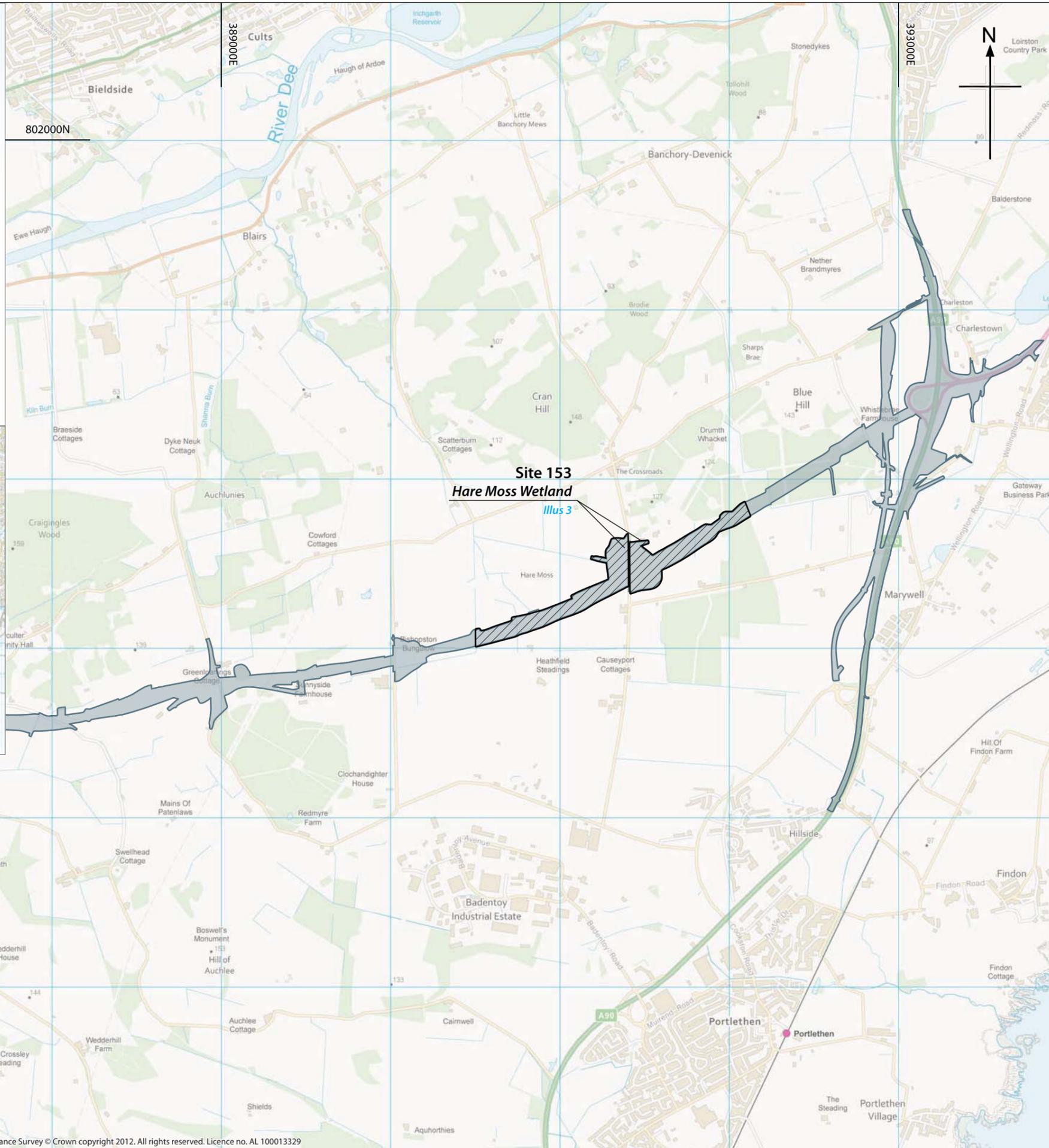
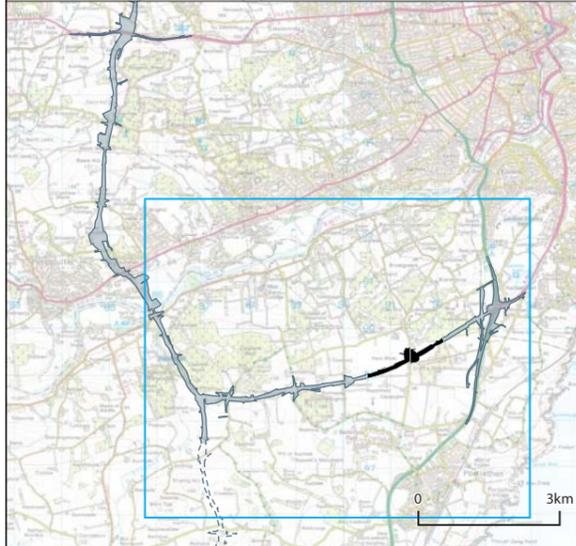
	07-22	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	22-57	Black, slightly clayey peat with monocotyledon plant fragments and wood fragments.	2
	57-59	Wood fragment	2
	59-69	Black, slightly clayey peat with monocotyledon plant fragments and wood fragments.	2
	69-70	Wood fragment	2
	70-76	Black, slightly clayey peat with monocotyledon plant fragments and wood fragments.	2
	76-90	Wood fragment	2
	90-128	Dark brown reed peat with visible <i>Phragmites</i> fragments.	2
	128-136	Grey clay with coarse sand and sub-angular to angular gravel inclusions.	3
	136	Stone	-
27	0-06	Dark brown upper peaty podzol with modern roots	1
	06-20	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	20	Stone	-
28	0-07	Dark brown upper peaty podzol with modern roots	1
	07-20	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	20-60	Black peat with monocotyledon plant fragments.	2
	60-100	Black peat with monocotyledon plant fragments and wood fragments.	2
	100-110	Light grey, peaty, silty, clay with visible <i>Phragmites</i> fragments.	3
	110-118	Brown, silty, clayey peat with visible <i>Phragmites</i> fragments.	2
	118-119	Light brown, clayey silt with visible <i>Phragmites</i> fragments.	5
	119-130	Black peat with monocotyledon plant fragments and wood fragments.	2
	130	Stone	-
29	0-10	Dark brown upper peaty podzol with modern roots	1
	10-58	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	58	Stone	-
30	0-08	Dark brown upper peaty podzol with modern roots	1

	08-20	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	20-28	Light brown-grey silty medium to coarse sand with sub-angular to angular gravels.	4
	28	Stuck	-
31	0-07	Dark brown upper peaty podzol with modern roots	1
	07-28	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	28-32	Light brown silty, medium to coarse sand with sub-angular to angular gravels.	4
	32	Stuck	-
32	0-06	Dark brown upper peaty podzol with modern roots	1
	06-25	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	25-27	Red-brown silty, coarse sand with sub-angular to angular gravels.	4
	27	Stuck	-
33	0-09	Dark brown upper peaty podzol with modern roots	1
	09-29	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	Feb-30	Red-brown silty, coarse sand with sub-angular to angular gravels.	4
	30	Stone	-
34	0-15	Dark brown upper peaty podzol with modern roots	1
	15-37	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	37-40	Black peat with monocotyledon plant fragments	2
	40-41	Brown silty peat with monocotyledon plant fragments and coarse sand inclusions.	2
	41-49	Light grey silty medium to coarse sand.	4
	49	Stone	-
35	0-09	Dark brown upper peaty podzol with modern roots	1
	09-24	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	24-29.5	Black peat with monocotyledon plant fragments and wood fragments.	2
	29.5-30	Wood fragment	2
	30	Stone	-

36	0-20	Dark brown upper peaty podzol with modern roots	1	
	20-52	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1	
		Dark brown peat with monocotyledon plant fragments and wood fragments.	2	
	52-91	Dark brown reed peat with visible <i>Phragmites</i> fragments.	2	
	91-123	Dark brown-black peat with monocotyledon plant fragments and occasional charcoal fragments.	2	
	123-146	Dark brown peat with monocotyledon plant fragments and wood fragments. Visible <i>Menyanthes</i> seeds present.	2	
	146-160	Grey fine sandy silt.	5	
	160-163	Blue-grey fine sandy, silty clay	3	
	163-165	Grey-brown clayey silt	5	
	165-169	Blue-grey medium to coarse sandy, silty clay.	3	
	169-171	Blue-grey silty, clayey medium to coarse sand.	4	
	171-175	Stone	-	
	37	0-10	Dark brown upper peaty podzol with modern roots	1
		10-34	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
Very wet black slightly clayey, peat with monocotyledon plant fragments.			2	
34-65		Dark brown-black peat with monocotyledon plant fragments and frequent sub-angular to angular gravels and coarse sand inclusions.	2	
65-83		Stone	-	
83				
38	0-08	Dark brown upper peaty podzol with modern roots	1	
	08-22	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1	
		Dark brown peat with monocotyledon plant fragments and wood fragments.	2	
	22-162	Dark brown reed peat with visible <i>Phragmites</i> fragments.	2	
	162-167	Stone	-	
39	0-07	Dark brown upper peaty podzol with modern roots	1	
	07-24	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1	
		Stone	-	
40	0-05	Dark brown upper peaty podzol with modern roots	1	

	05-20	Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	20-20.5	Black humified peat band.	2
	20.5-22	Dark brown peat.	2
	22-37	Brown silt with orange medium to coarse sand inclusions and sub-angular to angular gravels.	5
	37	Stone	-
41	0-09	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	09-23	Stone	-
	23		
42	0-06	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	06-18	Stone	-
	18		
43	0-06	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	06-16	Red-brown medium sand.	4
	16-21	Stone	-
	21		
44	0-07	Dark brown upper peaty podzol with modern roots	1
		Dark brown peaty podzol with inclusions of sub-angular to angular gravels and medium to coarse sand.	1
	07-19	Red-brown medium sand.	4
	19-29	Stone	-
	29		

9.2 Appendix 2 Illustrations



LEGEND

- Proposed road corridor
- Site

0 1km
Scale 1:25,000 @ A3



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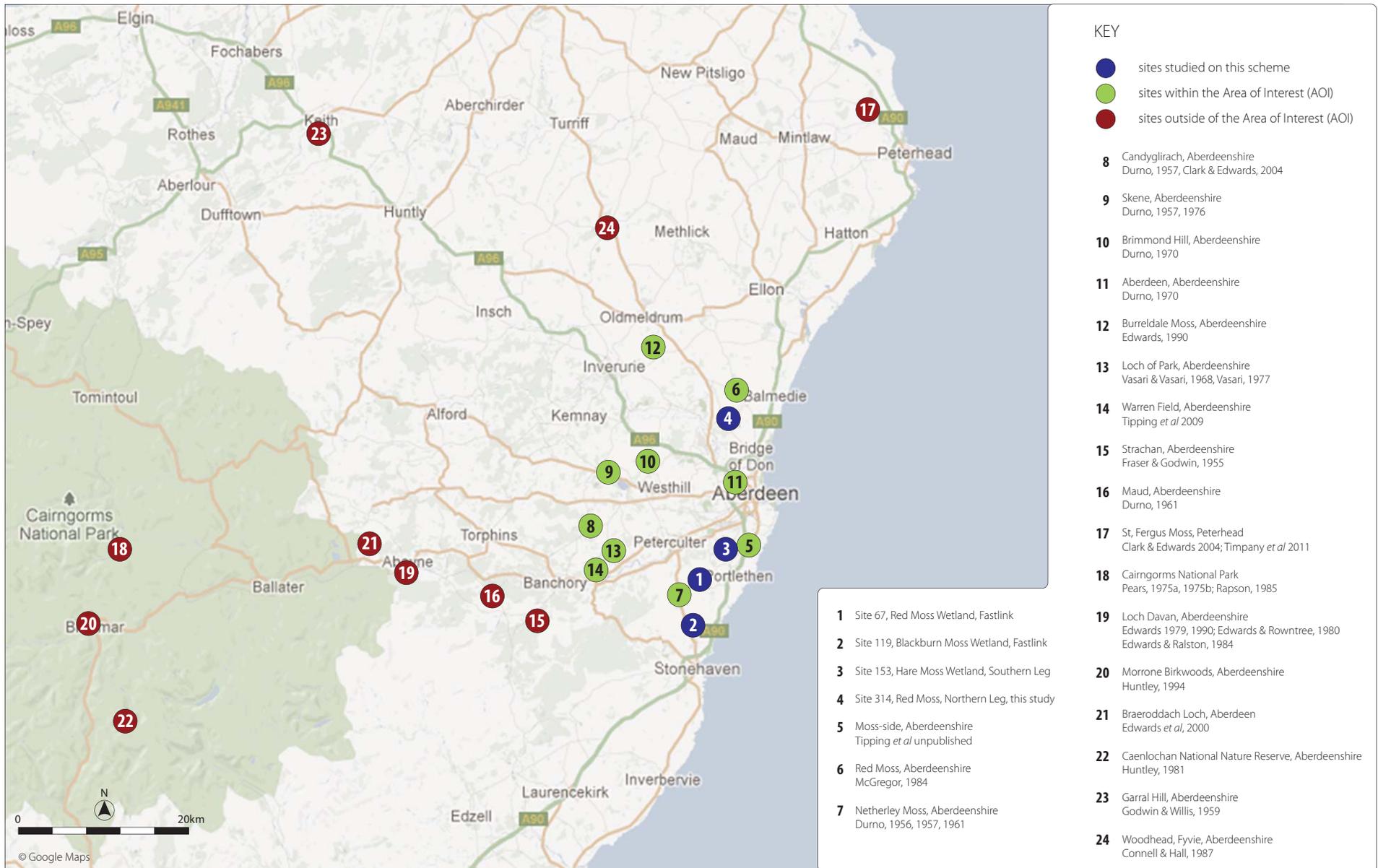


Drawing title
Illus 1
Site location plan

Drawing status
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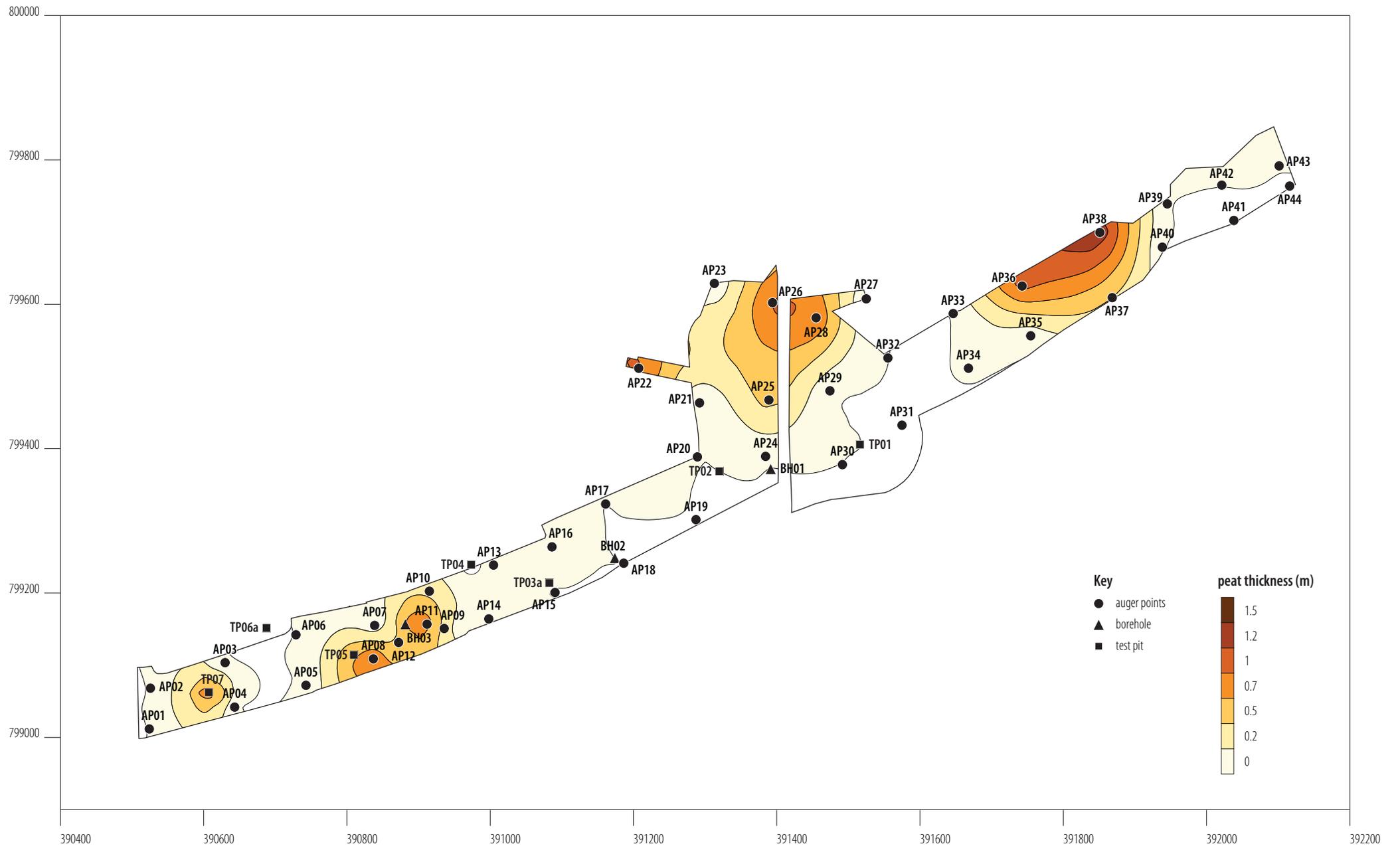
Headland Archaeology Drawing No.: Illus 1
Based on Drawing No.: 81033200/CD/3000/CH/008-011 (ITT Appendix B) Rev

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Illus 2

Map showing palaeoenvironmental studies in Aberdeenshire



Illus 3

2D contour map of peat thickness for, Site 153, Hare Moss Wetland. For location plan, see Illus 1